Back to Energy's Future? Notes

This presentation begins by revisiting energy's history and the energy resources used to generate electricity as a backdrop to addressing the problems associated with using 100% "renewable" energy resources for generating electricity.

Slide 2 – road from agrarian to industrial economies

- slide illustrates how Industrial Revolution transitioned many countries in western world from agrarian economies to industrial economies
- increased energy density of fossil fuels was key to transition, enabling urbanization and industrialization
- advent of abundant fossil fuels gave rise to significant improvements in sanitation, hygiene, nutrition, and medical care that resulted in increased human lifespan

Slide 6 – problems with 100% renewables

- in addition to unreliability of renewable energy resources, other problems include
  - materials availability (esp. rare earth elements)
  - economics (require government subsidies to be competitive)
  - supply chain issues (heavy reliance on Chinese materials)
  - waste/environmental issues (both in manufacturing and waste disposal)
  - safety issues (e.g., wind turbine failures and toxic waste disposal)

Slide 8 – reality of 100% "renewables"

- invisible elephant in room with Green New Deal, whether implemented by federal or state governments, is staggering quantity of material to be mined to build all green machines, and where that mining and processing happens
  - International Energy Agency predicts demand for just lithium used to produce lithium-ion batteries will increase 100-fold by 2050, followed by soaring new demand for graphite, cobalt, manganese, nickel, and copper
  - when entire life-cycle for generating electricity from "renewable" energy resources considered, "renewable" resources no more environmentally friendly than fossil resources

Slide 9 – reality of 100% "renewables" (cont.)

- according to Princeton University Net-Zero America study, achieving net-zero emissions by mid-century through renewables alone would require tripling of electricity transmission systems to

move energy generated in far-flung solar and wind farms to population centers

Slide 11 – minerals used in energy technologies graphic

- graphic compares quantity of minerals required for alternative transportation and electricity generation technologies
- note that steel and aluminum requirements not included in graphic
- mineral requirements for vehicle transportation shown in kilograms per vehicle
- mineral requirements for electricity generation technologies shown in kilograms per megawatt of electricity produced
- required mining and processing infrastructure capacities to meet demand for every category of mineral necessary for alternative technology transition paths **don't yet exist**

Slide 13 – "renewable" energy culminates in non-recyclable waste

- National Renewable Energy Laboratory scientists in Golden, CO warn that in next few decades, world faces tidal wave of used, non-recyclable turbine blades that will number hundreds of thousands, if not more

Slide 16 – subsidies paid to each energy source graphic

- graphic from U.S. Energy Information Administration data clearly shows renewable energy industry is subsidy-based industry, as wind and solar largely dependent on lucrative state and federal subsidies
- subsidy is direct payment to ongoing business by taxpayers
- if solar and wind such "cheap" technologies, public money should not be required to keep them competitive with other energy resources
- solar and wind technologies have been in energy market for more than 30 years; not "emerging" technologies requiring development subsidies
- requiring solar and wind generators to bear full costs of backup, storage, and transmission needed to provide reliable electricity would end unfair practice of socializing costs of intermittent generation across ratepayers or the grid

Slide 17 – subsidies per megawatt hour produced for each energy source graphic

- graphic illustrates subsidies paid per MWh of electricity produced
- solar industry clearly most heavily subsidized energy industry in U.S.

Slide 20 – levelized cost of energy (cont.)

- on extremely windy days, when wind turbines may need to be shutdown to prevent destruction, additional grid load balancing costs will be incurred

- with (over-built) all-renewables electricity grid, additional operating costs incurred when more electricity produced on very windy or sunny days than grid can accommodate (i.e., an oversupply), and electricity generation must be curtailed

Slide 21 – levelized cost of energy graphic

- graphic shows Levelized Cost of Energy per megawatt-hour for Minnesota's existing nuclear, natural gas, and coal plants versus 100% carbon-free electric grid, **including cost of providing electricity service after accounting for reliability differences in dispatchable and non-dispatchable (renewable) resources**
- graphic clearly illustrates massive overbuilding that must occur (dark gray portion of wind and solar bars) to ensure a grid with high reliance on wind, solar, and battery storage meets electricity demand at every hour of every day

Slide 23 – wind turbine land use issues

- many projects encounter NIMBY (not in my backyard) response from potential neighbors, especially wealthy neighbors – even wealthy people pushing "renewable" energy projects in name of curbing man-made global warming don't want to live near energy projects that are blight on their environment

Slide 24 – U.S. wind and solar project rejections graphic

- graphic illustrates rejection of U.S. wind and solar projects from 2015 through 2025
- wind and solar projects marketed as "green," "clean," and "renewable," but across rural America local communities rejecting them
- community opposition so strong that four Democrat-controlled states (California, New York, Illinois, and Michigan) passed legislation stripping local communities of zoning authority over big wind and big solar projects

Slide25 – wind turbine environmental issues

- actual environmental disruptions necessitated by many wind turbine projects may not be adequately communicated in proposal stage
- one question not adequately addressed is, will wind turbine ever generate as much energy as invested in building it

Slide 28 – the renewables transmission problem graphic

- graphic shows transmission problem associated with 100% renewables-generated electricity
  - based on May 2022 Dept. of Energy press release and current rate of transmission line growth, 60% grid expansion required

to meet 2030 renewable energy goals will take 84 years to build
    - 100% expansion of America's high-voltage transmission grid, minimum required to meet 2050 renewable energy goals, would take ≈140 years
- surge in land-use conflicts facing wind and solar projects across country combined with widespread rural America opposition to high-voltage transmission projects indicates massive expansion of grid will not happen
- despite never-ending hype about renewable energy, simply no way U.S. will be able to double, much less triple, amount of high-voltage transmission capacity needed to accommodate envisioned wind and solar projects on any time frame that makes sense

Slide 29 – the transmission problem (cont.) graphic

- graphic shows steadily increasing cost per mile of new high-voltage transmission
    - cost of expansion needed for 100% renewables grid is mind-boggling
    - each mile of new high-voltage capacity added to grid in 2023 cost about $3.95 million, nearly triple per-mile cost recorded in 2008
    - even if cost unaffected by inflation and other factors, doubling transmission capacity would cost consumers ≈$1 trillion

Slide 31 – energy storage system problem

- energy storage to back up predominantly wind/solar generation system to achieve Net-Zero is enormous problem, and very likely unsolvable
    - no proven energy storage solution that can take wind/solar electricity generation system to Net-Zero emissions, or anything close to it
    - short of a miracle, no possibility that any suitable storage technology will be feasible, let alone affordable, in any timeframe relevant to announced plans of politicians

Slide 35 – battery energy storage system graphic

- graphic representative of battery energy storage system generally proposed as solution to intermittency problem of solar and wind energy
- note 6-foot man standing at rear of system

Slide 38 – battery challenge graphic

- graphic shows seasonal variation of California electricity generation, where 40% of electricity generation comes from solar and 40% from wind

- illustrates problem associated with limited duration of backup battery operation
  - — huge battery banks needed to make up difference in California peak electricity demand when wind and solar generation drops precipitously in late summer
  - — batteries not well suited to filling gaps lasting days, weeks, and even months when wind and solar generation declines
  - — cost of required batteries would be astronomical

Slide 39 – the battery problem (cont.)

- real battery issues associated with 100% renewables grid have yet to be seriously addressed
- although entrepreneurs and government officials have spent lots of money pursuing practical and economical mass battery storage for decades, efforts have resulted in very limited success

Slide 40 – the battery problem (cont.)

- currently no single standard or parameter for assessing battery safety and no fire prevention system design standards or test criteria for battery energy storage systems

Slide 42 – Tesla megapack webpage

- webpage lists battery energy storage system cost at ≈$260 per kWh, with escalating maintenance cost of 2% per year

Slide 44 – battery storage reality check (cont.)

- Dept. of Energy's National Renewable Energy Laboratory published extremely optimistic cost projections for grid-scale batteries of $143 per kWh in 2030 and $87 per kWh in 2050
- even assuming low-ball cost of $87 per kWh, total cost for 240-million MWh of battery storage (which does not include transitioning to all-electric vehicles) ≈$21 trillion (2022 U.S. annual gross domestic product ≈$23 trillion)
- clearly astronomical cost figures show that grid scale battery storage to make wind- and solar-generated electricity reliable simply impossible

Slide 46 – renewable energy supply chain problem graphic 1

- U.S. renewable energy industry very much dependent on foreign countries for acquiring raw materials
- graphic shows top 3 world producers of raw materials required for "renewable" energy facilities
- U.S. 100% reliant on foreign countries for 17 strategic minerals and over 50% reliant for 28 widely used minerals
  - — China is major source for half of 28 minerals
- while Democratic Republic of the Congo (DRC) mines 68% of world's cobalt, Chinese own or invest in 15 of 19 Congolese cobalt mines
  - — nearly 87% of cobalt ore leaving Congo refined in China

- Australia, top producer of lithium, exports most to China for refining
  - — China accounts for more than 60% of world's lithium refining capacity
- China supplies ≈60% of rare-earth elements for world

Slide 47 – renewable energy supply chain problem graphic 2

- graphic shows share of world processing of raw minerals required for "renewable" energy facilities
- U.S. renewable energy industry very much dependent on foreign countries, particularly China, for raw material processing
  - — China controls 90% of battery industry's cobalt supply-chain

Slide 48 – renewable energy supply chain problem (cont.)

- quite apparent that in 100% renewable energy scenario, China will control U.S. energy supply, and that can't be good
- Question: does it appear that China set the stage for the climate change hoax (aka man-made global warming) by capturing the worldwide processing capability for critical renewable energy materials?

Slide 53 – retreat to pre-industrial revolution (cont.)

- electricity already being rationed in California; current California government policies only make rationing more severe in years to come
- Green New Deal actions at both state and federal levels can only result in more extensive energy rationing across America
- manufacturing, construction, and final disposal of green energy generators uses more energy than they produce over short life; whole-of-life net energy production is negative

Slide 54 – crude oil vital to prosperity graphic

- primary usage of crude oil not for generating electricity
- crude oil manufactured into petrochemicals used to create
  - — physical structures and networks necessary for functioning of industrial society
  - — commodities essential to enable, sustain, or enhance societal living conditions and maintain surrounding environment
- while ≈46% of crude oil derivatives used to make transportation fuels for motor vehicles, planes, trains, and ships, about 54% used to create more than 6,000 products, including
  - — medicines
  - — cosmetics
  - — plastics
  - — synthetic rubber
  - — cleaning products
  - — asphalt

- petrochemicals are basis for virtually all consumer products that did not exist prior to 1800s

Slide 55 – life without petroleum video